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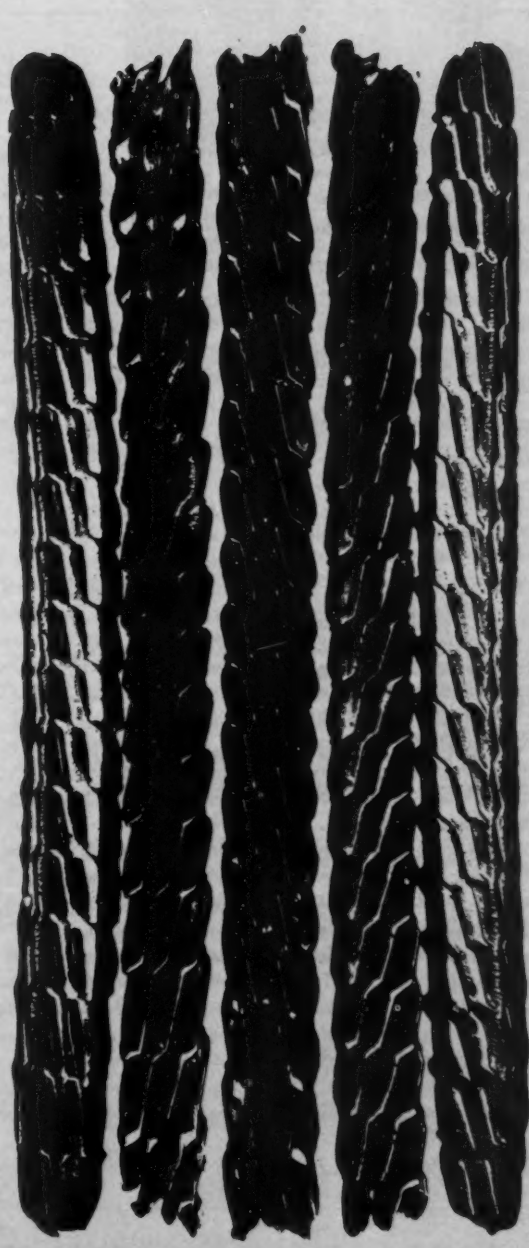
NATIONAL BUREAU OF STANDARDS

Technical News Bulletin



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Technical News Bulletin

JUNE 1970/VOL. 54, NO. 6/ISSUED MONTHLY

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COVER: A characteristic footprint of a bias-ply tire—slightly narrowed grooves at the center and slightly pinched in at the sides. *(See page 128.)*

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The National Bureau of Standards serves as a focal point in the Federal Government for assuring maximum application of the physical and engineering sciences to the advancement of technology in industry and commerce. For this purpose, the Bureau is organized as follows:

- The Institute for Basic Standards
- The Institute for Materials Research
- The Institute for Applied Technology
- Center for Radiation Research
- Center for Computer Sciences and Technology

The TECHNICAL NEWS BULLETIN is published to keep science and industry informed regarding the technical programs, accomplishments, and activities of NBS.

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REACTIONS IN THE LOW TEMPERATURE REGION INVESTIGATED

Richard D. Kelley, Ralph Klein, and Milton D. Scheer discuss the graphic results of a hydrogen-olefin experiment.

LOW TEMPERATURE REACTIONS are being studied at the Bureau for a better understanding of the elementary steps in olefin oxidation and hydrogenation. This work and the techniques employed were first introduced by Ralph Klein and Milton D. Scheer of the NBS Physical Chemistry Division. The studies [1-6] were performed in the low temperature region (77-90 K) to reduce the complexity of the overall reaction by avoiding all high activation energy secondary reactions. The NBS scientists obtained new insights to a number of reactive systems, some of which occur in polluted atmospheres.

Focusing on elementary reaction steps, Klein and Scheer examined the reactions of atomic hydrogen (H) and atomic oxygen (O) with olefins, a class of organic compounds containing carbon and hydrogen, the carbon skeleton being arranged in straight or branched chains, and characterized by a C=C group. The technique is to condense a layer of the olefins, either with or without an inert diluent such as propane, at a temperature, for example, of 90 K. The layer is exposed to atomic hydrogen or oxygen in the gas phase, prepared by thermal dissociation of molecular hydrogen or oxygen on a heated filament of tungsten or rhenium respectively. After an appropriate time interval, the filament is cooled, the excess gas pumped away, and the condensed layer transferred by distillation to a gas chromatograph for analysis.

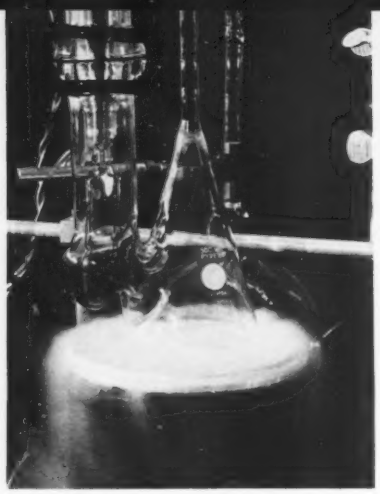
Evolving from this work was the discovery that an isotope effect was manifested in the positional rate ratio difference between the reactions of hydrogen and deuterium with an olefin. In an olefin in which the two carbons of the olefinic bond are not equivalent—that is, in nonsymmetrical types—the addition of hydrogen to the two positions occurs at quite different rates. As an example, Richard Kelley of NBS found that in the case of propene at 90 K, the ratio of hydrogen addition to the terminal compared to the non-terminal position, is 90. With the isotope deuterium, the ratio is 270.

This is a remarkably large isotope effect for an addition reaction, and is attributed to tunneling. The hydrogen, by virtue of its smaller mass, tunnels more effectively through the larger of the two potential barriers. The larger barrier is associated with the non-terminal position: the smaller barrier with the terminal position. The tunneling process leads, therefore, to a smaller ratio of terminal to non-terminal addition of the light hydrogen as compared to the heavier deuterium atom. This experimental finding is one of the few that provides positive evidence of tunneling in a chemical reaction.

The experiments with atomic oxygen led to a new concept for the transition intermediate in the oxygen atom-olefin reaction. It is known that one of the reactions in polluted atmospheres occurs between O atoms and olefins, producing eye irritating aldehydes and ketones. In the previously accepted model for this reaction, the transition complex was assumed to be a triplet diradical. Thus for 2-butene,

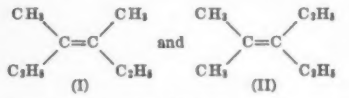
$$CH_3CH{=}CHCH_3 + O \longrightarrow CH_3\dot{C}H{-}\underset{\displaystyle \dot{O}}{\underset{|}{C}}HCH_3$$

By the processes of ring closure, hydrogen migration, and methyl migration, the products epoxide, ketone, and aldehyde are formed. The molecule 2-butene exists in two distinct geometrical isomers since there is no rotation about the olefinic bond. These are designated as cis- or trans-2-butene depending on whether the two hydrogens are on the same or opposite sides of the double bond. Previous work in the gas phase at room temperature showed no difference in reaction products between the cis and trans forms. These low temperature experiments, on the other hand, revealed an unusual stereospecificity. Four products, cis- and trans-2,3-epoxybutane, isobutyraldehyde, and 2-butanone, are formed. This cis compound gives a



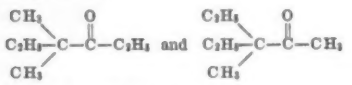
A dewar of liquid nitrogen cools the flask. Heater filaments in the attached tube dissociate the oxygen molecules.

ratio of 0.7 of the cis- to the trans-epoxy compound and 0.8 for the 2-butanone to the isobutyraldehyde. The trans-2-butene, in contrast, results in a ratio of 0.1 for cis- to trans-epoxide and somewhat more than 0.13 for 2-butanone to isobutyraldehyde. Unexpectedly, the ratio of cis-epoxybutane to isobutyraldehyde and the ratio of trans-epoxybutane to 2-butanone stayed constant even through large changes of the cis- to trans-epoxybutane ratio. The conclusion that each of the two sets of products are formed from two distinct precursor states is inescapable. An important set of observations was made on the two isomeric compounds.



(I) and (II)

In the O atom addition, two ketones are formed from either of these compounds,



If the rate of migration of the appropriate group (either CH_3 or C_2H_5) is decisive in fixing the ketone ratios, then it would be expected that the ratio of ketones from (I) would be inversely related to the corresponding ratio from (II). In fact, they are the same. From these and other facts obtained at cryogenic temperatures, Klein and Scheer were able to postulate a new, non-classical transition intermediate. The attack of the O atom is likely to be in the plane of the olefinic structure, and a weak interaction is present between the oxygen and adjacent hydrogens bonded to the olefinic carbons. The rearrangements that follow are of a concerted type. The newly proposed complex has proved useful in predicting the course of several O atom-olefin reactions. The predictions were verified experimentally.

The development of the field of cryogenic chemistry by NBS scientists has been fruitful in extending the understanding of several interesting and useful reactions. The prospects of extension of the methods developed to other systems offers promise of gaining further insights into chemical reactivity.

[1] Klein, R., and Scheer, M. D., Matrix effects in the gaseous H atom—condensed olefin system; surface reaction—olefin diffusion model, J. Phys. Chem. 66, 2677 (Dec. 1962).

[2] Klein, R., Scheer, M. D., and Kelley, R. D., Disproportionation-combination reactions of alkyl radicals and hydrogen atoms at low temperatures, J. Phys. Chem. 68, 598 (March 1964).

[3] Kelley, R. D., Klein, R., and Scheer, M. D., The cis-trans effect in the H-atom addition to olefins, J. Phys. Chem. 73, 1169 (April 1969).

[4] Scheer, M. D., and Klein, R., Low temperature oxygen atom addition to olefins. III. Transition state and the reaction with cis- and trans-2-butenes, J. Phys. Chem. 73, 597 (March 1969).

[5] Klein, R., and Scheer, M. D., Reaction of O(^{3}P) with 2-methyl-2-pentene at low temperatures and its implication for the transition state, J. Phys. Chem. 73, 1598 (May 1969).

[6] Klein, R., and Scheer, M. D., Addition of oxygen atoms to olefins at low temperature. IV. Rearrangements, J. Phys. Chem. 74, 613 (Feb. 1970).

STANDARDS AND CALIBRATION

STANDARD FREQUENCY AND TIME BROADCASTS

High-frequency radio stations WWV (Fort Collins, Colo.) and WWVH (Maui, Hawaii) broadcast time signals on the Coordinated Universal Time (UTC) system as coordinated by the Bureau International de l'Heure (BIH), Paris, France. The NBS time scale, UTC(NBS), and the U.S. Naval Observatory time scale, UTC(USNO), are jointly coordinated to within ± 5 microseconds. The UTC pulses occur at intervals that are longer than one coordinate second by 300 parts in 10^{10} during 1970, due to an offset in carrier frequency coordinated by BIH. To maintain the UTC scales in close agreement with the astronomers' time, UT2, phase adjustments are made at 0000 hours Greenwich Mean Time (GMT) on the first day of a month as announced by BIH. *There will be no adjustment made on July 1, 1970.*

The low-frequency radio station WWVB (Fort Collins, Colo.) broadcasts seconds pulses without offset to make available to users the standard of frequency so that absolute frequency comparisons may be made directly, following the Stepped Atomic Time (SAT) system. Step time adjustments of 200 ms are made at 0000 hours GMT on the first day of a month when necessary. BIH announces when such adjustments should be made in the scale to maintain the seconds pulses within about 100 ms of UT2. *There will be an adjustment made on July 1, 1970. The seconds pulses emitted from WWVB will be retarded 200 ms.*

NBS obtains daily UT2 information from forecasts of extrapolated UT2 clock readings provided by the U.S. Naval Observatory with whom NBS maintains close cooperation.

METRIC STUDY ENTERS DATA GATHERING PHASE

Questionnaire To Be Mailed Soon

THE U.S. METRIC STUDY is entering its most searching phase, that of data gathering through questionnaires and special surveys. Collection of data, largely through the cooperation of industry and other groups, is a vital step on the way to writing a final study report. According to NBS Director Lewis M. Branscomb, "This survey, regardless of the final U.S. decision on the question of metric usage, will present more solid data on the importance of a viable measurement system to a highly technological society than has ever been available before."

The rapidly diminishing worldwide use of the "customary" system of measurement units, foot-pound-gallon, and the corresponding rise in metric usage, meter-kilogram-liter, prompted the passage of Public Law 90–472. This law authorizes the Secretary of Commerce to conduct a program of investigation, research, and survey to determine the impact on this country of such increasing worldwide and domestic use of the metric system and to determine what action, if any, should be taken in the United States as a consequence.

The answers to several key questions are being sought in the study. How much is the metric system used now in this country? Would accelerated increase of metric usage be in the best interest of the United States? If so, should the country follow the present practice of having each sector of our economy increase its metric usage if and when it sees fit to do so, or should it follow a planned schedule of increased metric usage so that over a reasonable and advantageous period of time (the length of which is to be determined in the study) all sectors of the economy will convert to metric to the extent that it is feasible to do so in accord with a coordinated plan?

Responsibility for the study was assigned to the National Bureau of Standards. The first phase of the study dealt with planning and development of key questions to be answered by the study and identification of economic sectors requiring survey, and other areas to be investigated such as engineering standards and history. This year, phase two of the study involves data-gathering through questionnaires and special survey techniques. Next year's timetable calls for analyzing the data and writing the report, with recommendations by the Secretary of Commerce on the best course of action for the United States.[1]

Planning and Assumptions

Preliminary planning led to the conclusion that the following areas should be studied: manufacturing industry; nonmanufacturing industry; Federal, state and local government impact; international implications, particularly with respect to international trade; history of metric debate in the U.S.; engineering standards problems; commercial weights and measures activities; consumer attitudes and problems; educational issues; and impact on labor. The studies will be made by conducting surveys and holding national conferences.

Increased metric usage, of course, can take either or both of two distinct forms—one, by merely changing the measurement language in which an object is described, and the other by physically changing the size of the object to conform to a metric standard (the latter, of course, incorporates the language change). The physical change, or "hardware" aspect as it is sometimes called, by its nature results in much greater impact than the language change, not only in terms of cost but also in terms of "involvement." This change includes the question of metric engineering standards, the interlocking characteristics of

various segments of industry in the fabrication process (e.g., mating of components such as metric-sized fasteners to fit into metric-sized threaded holes), and the availability of metric-sized materials and parts called for in the specification.

In framing survey questions for the U.S. Metric Study, certain realistic assumptions had to be made:

- In all manufactured products the use of the metric system would be increased only in new or redesigned items.
- Items in use—whether by the manufacturer, the consumer, the service shop, or the sales establishment—would not be converted to metric until they needed replacement. However, even then, such replacement would not occur if it was impractical to do so. By way of illustration, the size of electric outlets and plugs and the spacing between the screw-holes of outlet face plates would not be changed, nor would the gage of railroad tracks, although at some future date engineering handbooks would show railroad gage to be 1435 millimeters instead of 4 feet 8½ inches.
- An exception to the above rule would be weighing and measuring devices and equipment used in commercial trade. Existing equipment would be changed to metric on a specified time schedule.

From the beginning, the NBS realized that any governmental action with regard to increased metric usage would depend on an appraisal of the likely effects of a changeover on producers and consumers for all economic sectors as well as international considerations.

The Federal Surveys

Congress, aware that any decision to change the system of measurement must take into account the impact on the military, made specific reference to investigate the "military advantages and disadvantages" of increased metric usage in the United States. The Department of Defense immediately undertook the task, designating the Air Force to lead the study. Guidelines were completed some months ago and the study is now well under way. Documentation will be ready by July 1970 and major command levels are expected to report their findings to DoD by September. Synthesis of DoD results into the final NBS report is scheduled for December. NBS is coordinating a similar study involving all other Federal agencies. As with the DoD study, the object is to assess the effect of increased metric usage on such systems as transportation and communication.

Manufacturing Industry Survey

The approach decided upon was a two-part manufacturing industry survey. Part A is general in nature, with questions designed to be answered by executives familiar with overall operations of their company. These questions probe into the extent and rate of increase of current metric usage. It became apparent early in the study that the question, "What percentage of your production is metric?" had no meaning. Consider the paint manufacturer who merely imprints the metric term, "3.785 liters," on the label of the gallon container. Is he 100 percent, fifty percent or 1 percent metric? Accordingly, only selected segments of the production process for which a proportion can be estimated are being weighed in the study, in order to provide an index to arrive at a current inventory of metric measurement use. To arrive at a "rate," the questionnaire asks for extent of usage 10 years ago, now, and expected usage 5 years from now for the same segments. Part A then proceeds to questions relating to metric usage in export trade and foreign operations, anticipated advantages and disadvantages if the company decided to metricate, what impact it foresees in the form of competition from imports, what changes it anticipates in its export trade, and their evaluation of the need for development of international engineering standards.

Part B of the questionnaire will yield data on the cost to industry if it were to increase metric usage on an optimum time schedule. Added manufacturing costs (basically, one-time costs) would include: development and adoption of new standards; replacement of engineering drawings; retraining of engineers, draftsmen, and operators; re-tooling and modification of production equipment by replacement of gages, dials, and feed-rate indicators; and increased inventories during the transition period. It already has been determined that for some manufacturing groups it would be impractical to produce hardware to metric standards. Oil-well equipment, which enjoys worldwide acceptance and usage in customary units of measurement, illustrates one such industry. Rolling stock for railroads is another.

Because the determination of added costs to a company requires expensive in-depth studies, only several hundred companies are expected to respond to the cost questionnaire. To make maximum use of the small sample, the manufacturing spectrum was divided into three broad categories:

- Industries with potentially substantial cost impact, particularly where mating of parts and assembly of components is required. Automobiles and machinery are examples.
- Industries in which the cost impact would be slight, because only language changes—such as in labeling and change of dials or gages to read in metric units—are involved. These relate primarily to companies that package their products (e.g., paint, canning, pharmaceutical, refining, and milling).
- Industries for which little or no cost impact would result. Examples include cutlery, periodicals, costume jewelry, and novelties.

Nonmanufacturing Industry Survey

The diverse nonmanufacturing industry includes such categories as agriculture, forestry, fisheries, mining, construction, public utilities,

wholesale and retail trade, finance, and services. There are subdivisions within each of these paralleling those described in the manufacturing survey.

The survey will employ statistical techniques in developing a probability sample from the Standard Industrial Classification (SIC) as established by the Bureau of the Budget and used by the Bureau of the Census in its surveys. One aspect not to be overlooked is the determination of whether the small business would face more serious dislocation than its larger competitors.

The survey will provide information for this sector of the economy to develop answers to the principal question "What action should be taken in the U.S. with respect to metrication?"

Education, Consumer, and Labor Surveys

Potential advantages of the metric system in the fields of education and science have been well understood for over a century, paving the way, for example, for the metrication of the pharmaceutical industry in the United States and for extensive, if not predominant, use of the metric system in the teaching of science courses in our secondary schools and colleges. But the bulk of our education and engineering community, serving the public and industries accustomed to the inch-pound-gallon system, has used the customary system of measurement in the instruction of our students and the training of our workers. Now the task is to see what the advantages are and what problems might develop from increasing metric usage in schools, by workers, and by the general public.

A separate study for each of these groups is planned. The current studies differ from previously described surveys in that the questions will be directed for the most part to associations or professional organizations representing population segments such as the student in the school, the housewife shopping at the store or cooking in the home, and the carpenter and other skilled workers in the construction industry.

These studies must address themselves to answering such questions as what changes in the education process would be necessary so that a society based on a metric system would best be served? What would be the problems and who would be affected? Would the skilled craftsman need to buy new tools? Would he find them easier or harder to use? Would the housewife really have to throw away her measuring utensils, her pots and pans? Where the study identifies potential problems, Congress wants the Secretary of Commerce to "recommend specific means of meeting the practical difficulties and costs" in any projected changeover.

Engineering Standards Study

Two of the key questions for which this study is seeking answers are:

- To what extent are U.S. standards incompatible with international standards because of the differences in the system of measurement?
- Can we retain and promote U.S. standards internationally whether or not there is a change in our measurement system?

A third question concerns the extent to which private U.S. standards bodies are participating in the development of international metric engineering standards, the extent to which they should increase their participation in the light of the growth of multi-national companies, and the extent to which the United States Government should encourage increased participation in international standards development if there is to be increased use of metric units.

Commercial Weighing and Measuring Activities

The problem in this specialized area stems from the necessity of adapting or converting existing scales and balances in all sectors of the economy to read out in metric units, if the United States switches to their use. Grocery store scales, gasoline pumps, and heavy-duty scales used in connection with railroad freight loads and highway truck loads are the most prevalent and most obvious segments of this problem. One pertinent area that needs to be analyzed is the phasing of any coordinated effort and what part, if any, of this effort should be on a local, state-wide, or Nationwide basis. The extent and diversity of this measurement area indicate why liaison with state and local government is necessary, especially since they have laws and regulations as well as inspection systems for implementing them. The NBS study seeks to assess the potential impact in these areas.

History

Since the founding of our Nation, there have been questions raised concerning use of metric units. In fact, Congress passed a Bill in 1866 legalizing, but not making mandatory, use of the metric system in trade and commerce. Since then, over 100 bills have been drafted that would lead to conversion to the metric system. This legislative history, being assembled as part of this study, not only is fascinating reading, but is illuminating as to how an aroused group can thwart or assist proposed legislation.

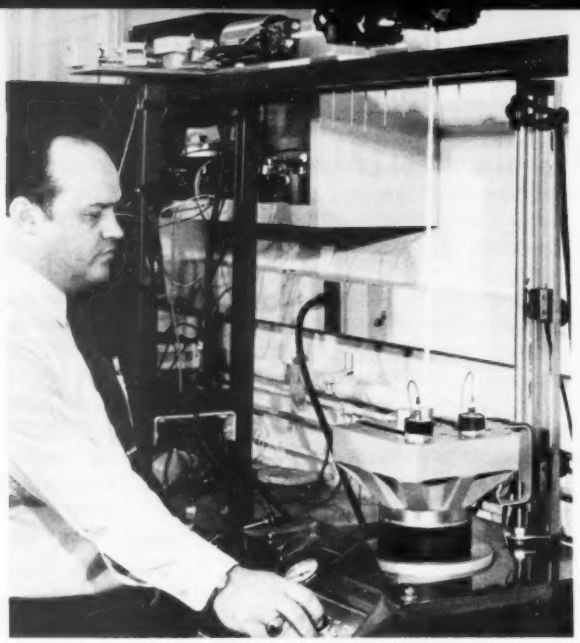
National Conferences

A series of national conferences will be held during the summer and fall of this year (1970), each investigating a specific major sector of the economy. The dates and topics of these conferences, all but one of which will be held in Washington, D.C., will be announced later. The exception, a week-long meeting sponsored jointly by NBS and the Engineering Foundation, will be held in mid-August at Deerfield, Mass. The interesting feature of these national conferences is that their broad-based approach, including all sectors, will supplement and give cohesion to the entire study.

[1] Public Law 90-472 calls for a report to Congress in August 1971. The planning of the study in its entirety was developed with this date always in mind. The report of the study will be made on schedule.

MECHANICAL SHOCK MEASURED OPTOELECTRICALLY

Laser Interferometer Calibrates Accelerometers



Lowell Ballard triggers vertical displacement of a shock test table for calibration of an accelerometer. Double exposure shows the path of the interferometer beam from and back to the cylindrical laser generator atop the overhead frame.

PHYSICISTS OF THE NBS INSTITUTE FOR BASIC STANDARDS have developed an interferometric system for measuring rapid displacements of moving surfaces. The system, designed by Lowell Ballard, William Epstein, E. R. Smith, and Seymour Edelman of the Bureau's vibration measurements laboratory, makes possible fast and accurate calibrations of shock accelerometers.[1] This work was supported by the Atomic Energy Commission, the Army Missile Command, and the Naval Ordnance System Command, which have had serious problems with the shortcomings of existing calibration methods.

Shock loads measured today include those simulating accidental impacts—such as automobile crashes—and intentional ones—such as the controlled impacts used in industry for measuring equipment performance, in testing component ruggedness, and in processing, as in metal forging.

Especially designed accelerometers are used to measure shock loads, which usually consist of single pulses containing much energy at harmonic frequencies. These accelerometers would ideally be calibrated with pulses having amplitude, shape, and duration simulating actual use. A suitable shock pulse can be generated, but its precise measurement poses special problems. The optoelectrical system devised at the Bureau for this purpose provides a means of accurately determining velocity, from which acceleration can be determined for calibration purposes.

Interferometric Measurements

The NBS laboratory team used interferometric techniques in developing methodology for measuring single-pulse displacement. Selected for the basic component was a Michelson interferometer having a beam reflected from optics moving with the surface subjected to shock motion. The scientists devised electronic circuitry to measure the velocity of the moving surface in terms of fringe movement.

A coherent light source—a laser emitting light of 632.8 nanometers—was selected to insure good fringe definition over the path lengths used. Movement of the reflecting surfaces at the target produces a Doppler shift in the reflected light, modulating the light frequency by an amount proportional to the instantaneous velocity of the surface. Movements of fringes created when the reflected beam is mixed with the reference beam are sensed by a photodetector, the signals from which are amplified, mixed with a 60-MHz signal, and demodulated by an FM discriminator. This process yields an electrical signal that is an analog of the velocity of the target reflecting surface.

System Design

The fixed optical components of the shock accelerometer calibration system are mounted on a frame passing over a commercial air-activated shock machine. The beam source is a commercial laser designed for interferometric applications and having built into it all interferometer components except the moving reflector. The beam path is horizontal except for a portion reflected downward to the target and back by 45-degree mirrors.

The method selected for measuring velocity is required to sense not only amount but also the direction of motion; it does this by circular polarization of the light to yield two signals. This is done to the laser beam before it enters the interferometer path; the beam returned from the target is combined with the reference

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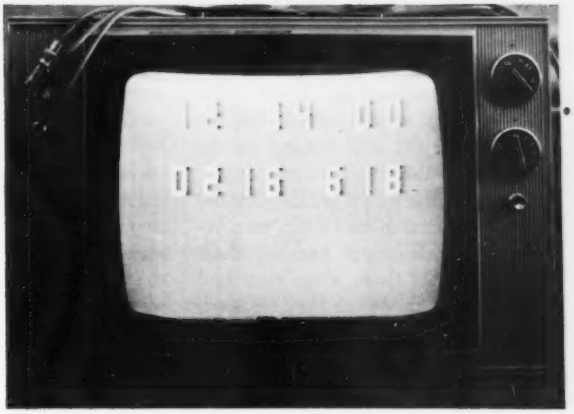
TIME DISSEMINATION AND CLOCK SYNCHRONIZATION VIA TELEVISION



A television station with an atomic clock can transmit the time of day with an accuracy of a few microseconds or better to every receiving set within range. An encoder puts the time on the broadcast signal. A decoder at the receiving set makes the time appear as numbers on the TV screen. The top numbers show the time of day at the transmitter, and the bottom numbers give the time difference in nanoseconds between the top line and a clock located at the receiver.

THE BUREAU (at Boulder, Colo.) has developed an electronic system for synchronizing clocks from coast to coast within a few millionths of a second by means of broadcast signals received on a modified television receiver. Not everyone needs such accuracy, of course, but for those who do the NBS development makes it quick, easy, and convenient. Potential private users include television and radio stations, power companies, airlines, universities, and radio amateurs. Among interested government users are NASA, the military services, the Environmental Science Services Administration, and the Geological Survey.

Required synchronization accuracies vary among organizations. Those who can tolerate millisecond inaccuracies generally use the NBS time and frequency broadcasts of station WWV near Fort Collins, Colo. Others requiring microsecond accuracy commonly carry a portable atomic clock by airplane from location to location synchronizing one clock after another. The flying clock system, besides being expensive, has the disadvantage of being unable to compare all clocks simultaneously. The NBS TV timing system overcomes both the cost and the sequential-synchronization objections to the flying clock system.

The TV system consists of an atomic clock in the broadcasting studio of a television network which puts a time code on the broadcast signal by means of a time-code generator. A decoder at the receiving end picks up the time code, translates it into hours, minutes, and seconds and displays it on the TV screen. Operational tests of the system have been carried on for several months by NBS with the cooperation of KLZ TV, Channel 7 in Denver, and KFBC TV, Channel 5 in Cheyenne.

Two fundamental characteristics of TV signals make it possible to use them to syncronize clocks. First, they always travel at near the speed of light, and second, they travel in the straight lines from transmitters to receivers. Since this is true, distances from one place to another via TV signal can be expressed in microseconds at the rate of about 5000 microseconds per 1000 miles. New York, then, is about 10 000 microseconds from Boulder. It follows that time broadcast from New York will be 10 000 microseconds slower, or behind, the master clock when its is received in Boulder. If a clock in Boulder is to be synchronized with the master clock, it must be set so it is 10 000 microseconds earlier than the time shown on the TV set.

To make this synchronization possible, NBS developed electronics which compares the time received by the TV set with a clock in the same laboratory and displays the difference between them on the TV screen. This line of numbers is updated each second and can show the difference not only in microseconds but in nanoseconds. With such resolution, an observer can tell the distance from transmitter to receiver in feet! (One foot corresponds to one nanosecond.)

Still another innovation that NBS scientists built into the decoder makes it self-checking. If it makes a mistake and comes up with a wrong number, the screen turns red where the numbers appear on a color set, and bars appear in the spaces between numbers on a black and white set.

Recently, Bureau scientists checked the equipment's performance against triangulation points established by the Coast and Geodetic Survey on the plains of eastern Colorado. With the TV transmitting antenna accurately

continued p. 126

TIME DISSEMINATION *continued*

fixed as to longitude and latitude, they equipped a van with a TV set and a portable clock synchronized with the transmitter clock and headed in the direction of the geodetic marker. A map showed them how far they should go and the accumulated difference between the studio clock and the clock in the van told them when they had gone far enough. When they stopped, the marker was there.

The geodetic-marker test was just one of many made by NBS to determine the reliability of the TV timing system. Not only the electronics of the encoder and decoder are involved, but also the stability of television signals themselves. Tests on the latter involved paths between Washington, D.C., and Boulder, Colo., and between New York and Boulder.[1] These tests proved that in a month's time the microwave paths were repeatable (and therefore predictable) within one or two microseconds. Day-to-day variations are less than half a microsecond. Local broadcasts are stable within nanoseconds.

The future of the TV timing system is still a matter of speculation, but its potential is well defined. Just three master clocks in the studios of the major networks in New York could serve 70 percent of the population of the United States. The time signals would ride on waves carrying the regular programs at no extra cost in getting them to users. For those not interested in timing, TV programs would come through unaffected by the time signals. The only cost to a user with a TV set would be for a decoder. Parts for the prototype decoder cost $400. The cost of a commercially built unit is unknown, but even if it were 10 times the cost of the parts, the proposed system would be thousands of dollars cheaper than any other synchronization equipment of comparable accuracy.

On the negative side, regular transmission paths might be interrupted, e.g., if a storm knocks out a relay station, then the signal would have to take a different route. Perhaps alternate routes could be determined in advance and the correction factor precalculated to overcome this possibility. Another drawback is the practice of local stations taping network programs for release at a more convenient time. There still would be a sufficient number of live broadcasts to keep laboratory clocks adequately calibrated.

Actual value of the system will be determined by additional operational tests. The U.S. Naval Observatory at Washington, D.C., and NASA's Goddard Space Flight Center in Greenbelt, Md., will conduct such tests this summer with equipment supplied by NBS Boulder Laboratories.

[1] Davis, D. D., Jesperson, J. L., and Kamas, G., The use of television signals for time and frequency dissemination, IEEE Proc. Letters, June 1970.

MECHANICAL SHOCK *continued*

beam and then is split and each half passed through a polarized screen before detection. The two screens differ in plane of polarization by 90 degrees, so that at any instant the phases of light in each channel differ by 90 degrees. Photodetectors in each fringe presentation sense fringe movement as a change in light intensity at their apertures.

The two photodetector signals are amplified and fed to a single-sideband carrier-insertion circuit to modulate a locally generated 60-MHz signal. The resulting signals drive a frequency-sensitive discriminator; the polarity of its output indicates the direction and its magnitude the velocity of the motion. Since acceleration is differentiated velocity, the discriminator output can be differentiated electrically to yield an analog of acceleration. In tests this signal was found to agree closely with the output of an accelerometer for frequencies of interest.

The principal uncertainties in the velocity measurement are attributable to the electrical calibration of the discriminator and final voltage measuring device.

Use of System

An accelerometer whose sensitivity is to be determined is mounted with the target reflector on the shock motion generator table. The instantaneous outputs from both the accelerometer and the velocity-measuring system are measured during shock by high-speed voltage sensing instruments and converted to computer-compatible form by analog-to-digital converters. The digital outputs are sent to an on-line computer, which stores the instantaneous voltage readings in its magnetic core memory. At the end of the shock pulse, the computer executes a program employing a Fourier transform of both the acceleration and velocity signals. The velocity signal is mathematically differentiated to obtain a reference acceleration signal. The two acceleration signals, one from the accelerometer and the other from the interferometer, are compared to obtain the sensitivity factor of the accelerometer being calibrated. Phase information also is calculated as part of the calibration process.

The system will be capable of calibrating accelerometers for various pulse shapes, peak acceleration amplitudes and pulse widths ranging from 15 *g* at 50 milliseconds to 10 000 *g* at 200 microseconds. This optoelectrical shock system will enable the Bureau to add the calibration of shock accelerometers to its services during 1970.

[1] Ballard, L. D., Epstein, W. S., Smith, E. R., and Edelman, S., Optical FM System for Measuring Mechanical Shock, Nat. Bur. Stand. (U.S.), J. Res. 73C (Engr. and Instr.), Nos. 3 and 4, 75–78 (July–Dec. 1969).

PILOT STUDY ON PRETRIAL RELEASE OF CRIMINAL DEFENDANTS

NBS Analysis of "Bail" Procedures

ANALYSTS of the NBS Institute for Applied Technology have compiled criminal court data in the District of Columbia for use in analyzing the practice of pretrial release. The analysis used as its data base four weeks of detailed information about individuals charged with committing crime. It examined any instances where these individuals were charged with additional crimes when free on pretrial release—such as "out on bail." The study was conducted under John W. Locke and Richard T. Penn, of the Bureau's Technical Analysis Division, for the National Institute of Law Enforcement and Criminal Justice, the research arm of the Law Enforcement Assistance Administration (U.S. Department of Justice).[1]

The study had four specific purposes. The first was to assemble the pertinent court data to determine what problems would be encountered in collecting the data and to recommend whether a full scale data collection program should be undertaken. A second purpose of the study was to attempt to derive an objective concept of "dangerousness" as applied to persons on pretrial release. The third purpose was to define an approach to developing a method of "dangerousness" prediction for use in reaching decisions for or against pretrial release in individual cases. The fourth purpose was to assemble, in one location, a basic set of records relevant to a wide variety of operational analyses in the criminal justice system.

The principal emphasis of the study was on collection and analysis of data recorded in the criminal justice system. These data alone are not sufficient to resolve the fundamental problems regarding pretrial release, but do indicate relative effects of various alternatives being suggested.

This investigation was conducted by a multidisciplinary operations research team that brought to the project expertise in the law, mathematics, psychology, economics, engineering, management, computer science, and sociology.

The data were collected by Georgetown University law students, who compiled information on a sample of persons charged with misdemeanors and felonies in the District of Columbia during four weeks of 1968. Sources for this information included files of the U.S. Attorney, court clerks, the magistrate, the grand jury, the bail agency, the jail, the Federal Bureau of Investigation, and probation officers—36 separate sources in all, within these offices. The sample included 712 defendants and 714 cases. Of the 426 defendants who received some form of pretrial release, 47 (11 percent) were rearrested. Seventeen percent of the 147 felony defendants released were rearrested, as were 8 percent of the 279 misdemeanor defendants. The 40 robbery defendants in the sample were analyzed in depth. An index was developed for the recidivists (defined as persons rearrested while on pretrial release). Analysis of the sample indicates that one rearrest can be expected for every 1000 days of pretrial release.

Precautions were taken to protect the privacy of individuals included in the sample; names and identification numbers are absent from the data and the statistics are given only as summaries. Primary emphasis was to obtain uniformly complete data and to record them accurately. The collection was coded and stored in computer-compatible form for the analysts' ease in handling. A useful by-product of this ordering is the resulting data bank, which should prove useful in exploring other questions of interest concerning the criminal justice system.

[1] Locke, John W., Penn, Richard T., Rick, John F., Bunten, Elaine D., and Hare, Gail B., Nat. Bur. Stand. (U.S.), Tech. Note 535, Compilation and Use of Criminal Court Data in Relation to Pre-Trial Release, in press, to be available from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.

MEASURING THE FOOTPRINT OF A TIRE

THE "FOOTPRINT" OF A TIRE might at first appear to have little significance except for studying traction and skidding, but measurements of tire contact area are used in studies of tire loading also. This area has been difficult to measure, although seemingly the measurement could easily be made by subtracting the area of the grooves from the entire contact area. However, the shape of the weight-supporting area is altered by pressure, load, and tire construction.

Tire research scientists of the NBS Office of Vehicle Safety Research now have a device for measuring the actual contact area of tires of any tread and construction. Instrumentation engineer Robert S. Pizer of the OVSR staff used optical and electrical techniques in designing the device in work for the Department of Transportation. The device determines contact area from a tire tread print in about 30 seconds. Tire footprint area measurements made with it are more accurate than appraisals by other means. Repeatability is excellent; successive measurements of a tread yield a standard deviation of 0.1 square inch for the same loading and inflation.[1]

Effect of Pressure and Loading

Tire pressure and loading are closely related to contact area; the area is reduced by increasing pressure or decreasing loading and, of course, is increased by lowered pressure or increased load. Tables of pressure-loading data are used by engineers to specify such things as tire type, maximum vehicle load, tire inflation pressure, and allowable tire substitutions. They can specify increased inflation pressure to accommodate greater load (within tire limitations) or reduced pressure for greater tire contact area—at the cost of increased flexing and heating.

Computing Contact Area

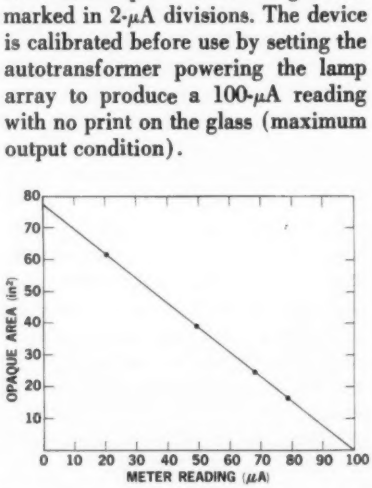
The contact area of a smooth, ungrooved tread could be computed from its dimensional measurements, but actual treads come in a variety of patterns which prohibit a simple calculation. Even areas obtained by subtracting from the total area that computed for the grooves are incorrect; distortion makes the round-ended rectangular outline we expect bulge inward at its sides for many tires and deforms the grooves. The extent of the deformations is a function of pressure and loading, and especially of tire construction (great for bias ply tires and essentially zero for radial ply-belted tires).

In the past, contact area has been computed from contact dimensions. Another approach has been to compute the elementary unit of contact area and sum this over the entire footprint. However, these methods are tedious and time consuming, the number of tread patterns is rapidly growing, and we are increasingly aware of errors resulting from distortion of the tread under load. A new, rapid, and fairly accurate method of measuring contact area was needed for use by both Government agencies and the tire industry.

Integrating Contact Area

The tire footprint-measuring device developed at NBS consists essentially of a plane source of light of uniform intensity, a glass plate on which the tire print is placed, and an optical system focusing the light passing through the plate on a photosensitive device. The illumination is supplied by 54 6-W lamps, which are evenly spaced in a 9 × 6 array. The light emitted from the translucent surface of an opal glass placed 5 inches above the lights is sufficiently uniform for accurate measurements.

A silicon solar cell is used as the photodetector. Its output is read on a 100-microampere meter having a scale marked in 2-μA divisions. The device is calibrated before use by setting the autotransformer powering the lamp array to produce a 100-μA reading with no print on the glass (maximum output condition).



Current reading vs. specimen area masked out shows the response of the footprint measuring device to be linear. The device meets two essential requirements—linearity and uniformity.

Testing and Using

The two essential requirements for the area-measuring device are that the intensity of illumination be uniform everywhere on the specimen plate and that a decrease in light flux be uniformly related to increase in specimen area blacked out. Uniformity of illumination was tested by observing the meter indication as equal areas on the specimen plate were masked by moving a piece of masking tape to successive positions on it. The decrease in current registered on the meter remained unchanged within its readable precision, indicating that the field is uniform.

The second condition was checked by masking incrementally increased portions of the specimen plane and plotting a graph of meter indication against percent of the area blacked out. This showed the relationship between the current and the area blacked out to be inverse and linear. The plot is a straight line between maximum current for no masking and no current for masking of the entire 77 square inches.

Tire footprints are obtained by inflating the mounted tire to the desired pressure, placing the wheel on a special hydraulic press, inking the portion to make contact, and placing an acetate sheet between the inked tread and the opposing surface representing the road. When activated the press closes slowly until it reaches the preset pressure and opens up again. The acetate sheet bearing the tire footprint is then removed and dried; the footprint on the acetate can then be placed in the optical integrator for measurement.

The ink used in making the impression was selected, with the assistance of the Government Printing Office, for high compatibility with both the rubber and acetate surfaces.

Different platens, the plates against which the tire is squeezed, are used in making the impressions. A flat platen is used to simulate normal roads. A curved one has the same curvature as the surface of the driving wheel of the Bureau's laboratory road-simulation equipment. Comparison of the contact areas using the two platens will be essential to determine the validity of using the laboratory wheel to represent a road and to determine if a correction factor is needed.

The scope of NBS automotive safety research is described in *Automotive safety research expanded at NBS*, Nat. Bur. Stand. (U.S.), Tech. News Bull. **51**(11), 246–248 (Nov. 1967).

NBS tire research is described in *NBS tire research program*, Nat. Bur. Stand. (U.S.), Tech. News Bull. **54** (1), 12–15 (Jan. 1970).

Measuring temperatures within running tires is described in *Thermistor takes temperature of running tire*, Nat. Bur. Stand. (U.S.), Tech. News Bull. **52**(6), 119–120 (June 1968).

[1] Pizer, R. S., and Spinner, S., An apparatus for determining the actual footprint area of tires, Mater. Res. Stand. **10**, 20–22, 63 (Feb. 1970).

Data from this footprint-measuring device, which Robert Pizer is using to measure tire contact area, are used to validate pressure-loading curves.

Peter Newfeld footprints the tread of an automobile tire on an acetate sheet.

NSRDS NEWS

The NSRDS was established to make critically evaluated data in the physical sciences available to science and technology on a national basis. The NSRDS is administered and coordinated by the NBS Office of Standard Reference Data.

THERMOPHYSICAL PROPERTIES RESEARCH CENTER SERVICES

The Thermophysical Properties Research Center (TPRC), Purdue University, provides authoritative information and data on the thermophysical properties of all substances through comprehensive search and collection of the world literature. The Center, under the direction of Y. S. Touloukian, generates tables of data in its program of compilation and critical evaluation of existing data, theoretical studies, and experimental determinations. It also conducts research on thermophysical properties of materials. TPRC is financially supported by the Department of Defense, the Office of Standard Reference Data, and by commercial organizations; however, only the project on critical evaluation of data, a small part of its overall program, receives financial support from the Office of Standard Reference Data.

In its data compilation activities, TPRC is concerned with more than 25 000 different substances for the following thermophysical properties: thermal conductivity, accommodation coefficient, thermal contact conductance, thermal diffusivity, specific heat at constant pressure, viscosity, emittance, reflectance, absorptance, transmittance, solar absorptance to emittance ratio, Prandtl numbers, diffusion coefficient, thermal linear expansion coefficients, thermal volumetric expansion coefficients, and surface tensions.

The project on the critical evaluation of existing data and generation of recommended reference data currently covers the thermal conductivity of elements, oxides, liquids, and gases at all temperatures from absolute zero to the highest temperature measured, as well as covering the specific heats of liquids and gases.

Thus far, two critical compilations of data have been published, NSRDS-NBS-8, *Thermal Conductivity of Selected Materials*, Part 1,[1] ($3, Clearinghouse No. PB189698), by R. W. Powell, C. Y. Ho, and P. E. Liley, and NSRDS-NBS-16, *Thermal Conductivity of Selected Materials*, Part 2,[2] ($2, SD Catalog No. C13.48:16), by C. Y. Ho, R. W. Powell, and P. E. Liley. A comprehensive publication on thermal conductivity of the elements is now in preparation.

To implement its claim to comprehensive coverage of the world literature, TPRC operates two overseas divisions; one is in Kobe, Japan, and the other in Brussels, Belgium. These branches help to provide better service to the technical communities in Asia and Europe. The affiliate in Japan is completing its sixth year of continued operation under the direction of Tadashi Makita at Kobe University. During the past year, Professor Makita and his group have developed tables of recommended values for the specific heats of fluids, including refrigerants in the liquid and vapor phases. TPRC European branch is located at the Belgian Institute for High Pressure (IBHP) and is in its fourth year of operation. The IBHP is concerned with data generation involving the viscosity of gases

and liquids. It is under the direction of Dr. Lewis Deffet with Dr. Pierre Hestermans serving as senior investigator.

TPRC offices at Purdue University receive many overseas visitors. Scholars from Belgium, Italy, Germany, and the U.S.S.R. are interacting with TPRC's program to contribute to TPRC's comprehensive coverage as well as to learn operations and procedures in documentation, critical data evaluation, and research in the area of TPRC's interests and competence.

The Thermophysical Properties Research Center invites inquiries from the U.S. and abroad. Communications should be addressed to Mr. William Shafer, Assistant Director-Technical, Thermophysical Properties Research Center, Purdue University, 2595 Yeager Road, West Lafayette, Ind. 47906.

COSATI DIRECTORY OF INFORMATION ANALYSIS CENTERS

The Committee on Scientific and Technical Information (COSATI) Panel on Information Analysis Centers, with the cooperation of the National Referral Center, Library of Congress, has issued a revised *Directory of Federally Supported Information Analysis Centers* [1] ($3, Clearinghouse No. PB189300).

As previously, the Directory is intentionally selective; inclusion was based on two specific qualifications: (1) The roster includes only those activities and programs operating within Federal Government agencies or being supported wholly or in part by Federal funds; (2) the roster includes only those activities that perform a majority of the functions within the scope of the Panel's definition of an information analysis center. The Panel's working definition or such a center was:

> An information analysis center is a formally structured organizational unit specifically (but not necessarily exclusively) established for the purpose of acquiring, selecting, storing, retrieving, evaluating, analyzing, and synthesizing a body of information and/or data in a clearly defined specialized field or pertaining to a specified mission with the intent of compiling, digesting, repackaging, or otherwise organizing in a form most authoritative, timely, and useful to a society of peers and management.

This publication should serve as a useful reference source for the identification of expertise in specialized fields. One hundred nineteen information analysis centers are listed in the Directory. Among information included for each entry are descriptions of mission, scope, services available, and user qualifications. For convenience, the Directory contains an index of subject areas covered, an index of names of center operators or directors, a list of organizations, and a list of locations. In addition, the centers are numbered serially to facilitate indexing.

COSATI Panel on Information Analysis Centers intends to keep the Directory current through issuance of either supplemental information or revisions at appropriate intervals. Users are requested to send omission or revision information to COSATI Panel on Information Analysis Centers, c/o the Office of Standard Reference Data, National Bureau of Standards, Washington, D.C. 20234.

CHEMICAL KINETICS INFORMATION CENTER LISTS OF PUBLICATIONS

The NBS Chemical Kinetics Information Center collects and disseminates information on rates of thermal chemical reactions, cross sections of reactive collision processes, and quantum yields of photochemical processes. The center locates reports and other literature on these processes, indexes the processes, establishes and maintains a reference file and a subject index of the literature, and prepares bibliographies on specific topics. Among the reference lists it has recently prepared are the following NBS Lists of Publications:

1. Rates of decomposition of inorganic nitrates in solid phase and as fused salts, NBS LP 59, June 1969.
2. Rates of atom- and group-transfer reactions of iodine atoms in the gas phase, NBS LP 60, June 1969.
3. Rate of recombination of iodine atoms in the gas phase, NBS LP 61, June 1969.
4. Rates of reactions of peroxy-free radicals in the gas phase, NBS LP 62, July 1969.
5. Rates for radical-radical reactions in solution, the liquid phase and matrices, NBS LP 63, July 1969.
6. Gas phase rates for combination and disproportionation reactions of organic-free radicals, NBS LP 64, July 1969.
7. Rates of water exchange between metal complexes and the solvent, NBS LP 65, August 1969.
8. Rates of reactions of alkali metals with halogens in gas phase, NBS LP 66, April 1970.

These lists are available from the Chemical Kinetics Information Center, National Bureau of Standards, Washington, D.C. 20234.

LOW-ENERGY ELECTRON-COLLISION CROSS-SECTION DATA

The first part of a compilation of low-energy electron-collision cross-section data prepared at the JILA Information Analysis Center (Boulder, Colo.) has been published in the September 1969 issue of the journal *Atomic Data*, Vol. 1, No. 1. The title of the critical compilation is Low-Energy Electron-Collision Cross-Section Data, Part 1. Ionization, Dissociation, Vibrational Excitation, by L. J. Kieffer. Part 1 is limited to experimental measurements, and includes data for all atomic species and for those molecules that are important in aeronomy, astrophysics, and plasma physics. The literature was searched for data through September of 1968. Included in this compilation are ionization cross-section graphs for H,

He, Li, N, O, Ne, Na, Mg, Ar, K, Ca, Cu, Zn, Kr, Rb, Sr, Ag, Xe, Cs, Ba, Hg, Tl, Pb, H_2, HD, D_2, N_2, CO, NO, O_2, HCl, Te_2, H_2O, CO_2, N_2O, C_2H_2, CH_4, CD_4, C_2H_4, SF_6, C_2H_6. Dissociation cross-section graphs are included for H_2, HD, D_2, N_2, CO, NO, O_2, HCl, HBr, I_2, H_2O, CO_2, N_2O, C_2H_2, CH_4, CD_4, SF_6. Vibrational excitation cross-section graphs are given for H_2, N_2, and CO. Included are a bibliography and an author index.

RATE DATA FOR ATOMIC OXYGEN REACTIONS

A critical review by John T. Herron of the NBS Institute for Materials Research has been published in the *International Journal of Chemical Kinetics*, Vol. 1, No. 6, Nov. 1969. The review is entitled, An Evaluation of Rate Data for the Reactions of Atomic Oxygen (O^3P) With Methane and Ethane. This review presents in tabular and graphical form rate data on the reactions of atomic oxygen (O^3P) with methane and ethane. The reliability of these data is discussed and suggested values of the rate constants are given over specified temperature intervals. Specific values are given for reactions at 298 and 1000 K.

Rate constants have been reported for the reactions of atomic oxygen with a large number of organic compounds. The methane and ethane reactions are among the most carefully studied of these reactions. The purpose of this review was to tabulate the available rate data for methane and ethane reactions (excluding data published before 1950), to discuss the reliability of these data, and to arrive at suggested values for the rate constants at specified temperatures over specified temperature intervals.

This review was partially supported by the NBS Office of Standard Reference Data. A limited number of copies are available and requests for them should be addressed to Dr. J. T. Herron, Institute for Materials Research, National Bureau of Standards, Washington, D.C. 20234.

HIGH TEMPERATURE CHEMISTRY AND PHYSICS

The latest in a series of current awareness bibliographies on high temperature chemistry and physics, prepared under the auspices of the Commission on High Temperature and Refactories of the International Union of Pure and Applied Chemistry (IUPAC), has recently been published as NBS Special Publication 315-3, *The Bibliography on the High Temperature Chemistry and Physics of Materials* [2] (55 cents, SD Catalog No. C13.10:315-3).

This issue, edited by J. J. Diamond, covers the period July through September 1969. Material for these bibliographies is gathered by scientists attached to the Commission. Part I on Solids and Liquids is compiled by members of the Working Group scanning the pertinent journals published in their countries, and in some cases in adjacent countries, while additional literature is covered by the editor. Part II on Gases is obtained by searching *Chemical Abstracts*. All titles are translated into English. The first issue in this series covered the period October–December 1957 and the series has appeared quarterly ever since, though with several changes in title, form, and content. It acquired its present format and status as an NBS publication with the issue that covers the fourth quarter of 1968. Those who wish to be notified when new installments of this publication are issued should write to the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402, and request that their name be added to Notification Key N-380.

THERMODYNAMIC PROPERTIES OF MOIST AIR

NBS Building Science Series-21, Algorithms for Psychrometric Calculations (55 cents, SD Catalog No. C13.29/2:21), by T. Kusuda has recently been published. This paper provides step-by-step procedures for computer-oriented engineers in calculating accurate values of moist air properties. The method was described by J. A. Goff in 1949, but had not been previously adapted to computer techniques. The computerized method makes it possible to extend the well known ASHRAE tables (which are based on the Goff method) up to barometric pressures of 3 atmospheres and temperatures of 400 K. In addition, the method is believed valid for a mole fraction composition of dry air different from that used in the original calculation of the tables mentioned.

Very accurate values of moist air properties are required for many engineering problems. Notable examples are psychrometric calorimetry for measuring capacity of air-conditioning apparatus, moisture transfer analyses in cold storage warehouses, and analyses of simultaneous transfer of heat and moisture affecting the physiological responses of living organisms. Workers in these areas will find this publication helpful.

NEUTRON CROSS-SECTION DATA

The European Nuclear Energy Agency (ENEA) Neutron Data Compilation Centre in its Newsletter Bulletin 10, CCDN-NW/10, December 1969, provides a semi-empirical evaluation of fast neutron capture cross sections of stable nuclei with $32 \leq Z \leq 66$. These data are also available on tape from the U.K. Nuclear Data Library. The ENEA Newsletter Bulletin 10 also contains a survey of total cross-section measurements for lead below 100 keV, as well as a list of the data available on ν for 252-Cf in the Neutron Data Compilation Centre Library.

[1] Order by PB number from the Clearinghouse for Federal Scientific and Technical Information, Springfield, Va. 22151, for the price indicated.

[2] Order by SD Catalog number from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402, for the price indicated.

FIPS NOTES

In the fall of 1965 the Secretary of Commerce established the NBS Center for Computer Sciences and Technology to carry out the Secretary's responsibilities under the Brooks Bill (Public Law 89–306, passed October 30, 1965). The Center provides leadership and coordination for government efforts in the development of voluntary commercial information processing standards, develops recommendations for Federal scientific and technical support and consultative assistance in the field of computers and information processing to Federal agencies. These Notes will cover information-processing standards activities in the Federal Government, particularly those of the Center.

PROPOSED STANDARD FOR IDENTIFICATION OF INDIVIDUALS FOR INFORMATION INTERCHANGE

A proposed American National Standard has been developed for uniquely identifying individuals for the purposes of information interchange by ANSI Subcommittee X3.8. This proposed standard has been forwarded to Committee X3, Computers and Information Processing, for publication and letter ballot. Within the Federal Government, this proposal is being reviewed and studied for acceptability as a Federal Information Processing Standard (FIPS).

Basically, the proposal provides a Standard Identifier for Individuals, called an SII, that consists of two parts—a number part and a name part. The number part is the Social Security Account Number (SSAN). The name part is the surname, first name, and middle name of the individual. A hypothetical example of an SII is as follows:

232-48-1847 Johnson,William, Robert/

The proposed standard is very explicit that neither the number nor the name alone is sufficient to uniquely identify an individual.

Some other essential features of the proposed standard are:

1. The SSAN is represented by eleven characters. Two of these characters are hyphens that are used as separators between the third and fourth numbers and between fifth and sixth numbers as 232-48-1874. (This provides for higher reliability by humans in recording and transferring the number accurately.)

2. The SSAN is separated from the name part by one space character.

3. The name part is represented as a variable length field terminated by a slant (or virgule).

4. Any of the graphic characters provided in the American Standard Code for Information Interchange (ASCII) may be used in a name with the exception of the slant, comma, left and right parenthesis, number sign (#), and period. These latter characters are used for syntax (punctuation) symbols in the name part. Also, both upper and lower case letters are to be used.

5. Titles such as General, Doctor, Reverend, Professor, Mister, Mrs. and Miss are not included in the name part. (In application, these can be treated as a separate element apart from the SII.) Names conferred upon or selected by individuals in the fulfillment of religious orders or rites are not acceptable as names of individuals unless such changes have been authorized by a civil official empowered to execute a change of name. (No "Friar Tuck's" in modern data systems.)

6. The name part consists of three sub-fields in the following sequence: Surname, First Name, and Middle Name.

a. When used, surname affixes (such as Jr., III, etc.) are considered part of the surname. These are placed after the surname and are enclosed in parentheses; e.g., Johnson(Jr),William,Robert/.

b. The name is to be recorded as provided by the individual—spacing and diacritical marks are to be accepted and recorded (e.g., Di Angelo or José).

c. Compound names are considered as one word regardless of how they are separated by a space or a hyphen (e.g., Smith Harding, John,Thomas/, or Smith-Harding, John,Thomas/, and Wilson,Jo Anne,Elaine/).

d. If the given name is an initial only, the initial will be recorded. (No period after the initial; e.g., Johnson,William,R/ or Johnson,W, Robert/.)

e. Each name part will contain two commas and a terminating slant. The commas separate the Surname from the First Name and the First Name from the Middle Name. In the absence of a First Name or Middle Name, the comma or commas will still be used (e.g., Johnson,William,/ or Johnson,,/).

f. The period is not used at all.

The proposed standard also provides for representing names other than the "record name" (Surname, First Name, Middle Name). These additional names such as maiden names, religious names, nicknames, aliases, stage names, and prior names are defined as complete names. However, these are not part of the SII.

Subcommittee X3.8 provided the following supporting documentation for the proposed standard:

Need and Justification for Standard for Identification of Individuals for Information Interchange

Most data processing systems require information about individuals from other systems or from sources other than internal records. It is not realistic to assume that all systems will now or in the future contain identical identifiers for individuals or that most systems contain information which is consistent or compatible with other systems. Despite these problems, responsible use of information about individuals requires that the identifying data be unambiguously understandable. Thus, there is a need for a standard system for identification.

One of the potential objections to a standard for individual identification is the fear that it will facilitate invasions of privacy; i.e., unwarranted association of data from individual files. Unfortunately, this issue is frequently cast in a framework that implies that all interchange is harmful or undesirable. Obviously, this is not the case.

Although some interchange may be undesirable, much interchange is legally established and politically or socially acceptable. Interchange is a necessity in the modern environment. We should aim for a system with direct control over interchange through safeguards and penalties relating to disclosure, rather than a system containing built-in indirect techniques intended to interpose technical barriers to interchange.

In fact, information abuse can occur whether or not there is a standard. Legal restrictions against the abuse of information would be impractical and probably unenforceable. Tight legal control could create an inflexible system leading to unnecessary expense and wastage, and might eventually inhibit technological advancement.

Matching can always take place through a bilateral agreement to use a common identification technique, since individual record keeping systems must be able to identify the entities on their records, irrespective of the existence of a standard. Lack of a standard would, therefore, not make association impossible; at most it would be more costly and more inaccurate and generally more time consuming.

Protection of privacy is an inherent feature of a non-significant identification code such as the social security number, since the code does not reveal any personal characteristics. In the absence of this type of code, the individual might be required to provide detailed identifying information to every record keeping system with which he comes in contact, even though such information might not be otherwise required. Thus, the use of a standard, non-significant code could reduce the extent of such personal data.

Problems of Unique Identification

Theoretically, unique identity can be established by virtue of one or a combination of personal attributes possessed uniquely by one individual and no other, in the universe under consideration. The determination as to which attribute or attributes are required to establish such identity must be based ultimately, on an analysis of the frequency of their occurrence in the universe under consideration.

The personal attributes selected for identification purposes should be stable over the lifetime of the individual. Most attributes, however, are not immune from instability. For example, instability of attributes may arise when there are legal changes of names, when memories fail, or when different information is supplied on different occasions. The attributes should be simple to obtain. The use of invariant physical characteristics (for example, finger prints) as attributes to provide unique identification is not practical for mass implementation at present, because of the cost and complexity of measuring the characteristics and coding them.

A name is needed in almost all records pertaining to an individual, but a name is not unique. Heretofore, heavy reliance has been placed on including personal attributes. The names and such additional data elements, however, have continued to be ambiguous when large numbers of persons are covered in a system—as is frequently the case today.

Problems of Ideal System

The simplest means of including additional data for unique identification is to assign a code unique to each individual to be identified in the United States.

Currently no single agency (governmental or non-governmental) has the authority and financing required to create and maintain an ideal code system. Lacking such a facility, existing and proposed systems were examined to determine their feasibility as unique identifiers.

Standard Identifier Concept

In a large scale system it is generally desirable, upon the first encounter of an individual with that system, to establish a unique code to refer to that individual. This code provides such advantages as the following:

a. Ease of processing of subsequent transactions, since a smaller amount of information is required for identification on subsequent transaction documents and on master file records. (The detailed data relating the code to the full set of attributes for identification may be carried in an auxiliary file.)

b. Fewer communication problems, in view of the smaller quantity of information needed to identify.

c. Greater stability, since the code need not be changed even if such attributes as the individual's name were changed. These changes can be reflected in the auxiliary records but need not affect other files.

Despite its uniqueness, the use of a code alone is insufficient, for data interchange purposes, to identify the individuals involved. The possibility of error in the initial recording or subsequent transmission of the code always exists. Another consideration is the possibility of public reaction to the depersonalization associated with the use of only a code for identification. For these principal reasons, the recommended Standard Identifier consists of a code uniquely assigned to an individual and the name of that individual.

Sheila M. Smythe, Blue Cross-Blue Shield, is the Chairman of ANSI Task Group X3.8.3, which developed the proposed standard.

Federal Government personnel who contributed in the development of this proposed standard include: Everett Alldredge, National Archives and Records Service, GSA; George Gallagher, Social Security Administration, HEW; Bernard Radack, Internal Revenue Service; Walter Schuler, National Division of Vital Statistics, HEW; Langston A. Spell, Federal Highway Administration, DOT; and John R. Staklo, Office of the Comptroller, DOD.

Copies of the proposed standard may be obtained from the NBS Office of Information Processing Standards, Washington, D.C. 20234. Refer to document number X3.8/128 (Revised).

VOLUNTARY STANDARDS ACTIVITIES

ANSI Committee X3 recently authorized a letter ballot for approval of two Electronic Industries Association Standards as American National Standards. They are RS-232-C, Interface Between Data Terminal Equipment and Data Communications Equipment, and RS-366, Interface Between Data Terminal Equipment and Automatic Calling Equipment for Data Communications.

It also authorized a ballot for approval of a draft American National Standard, Identification of States of the United States for Information Interchange.

In other actions, X3 approved a report of a working group on agreed-upon revisions to proposed American National Standard Z39.2, Bibliographic Information Interchange on Magnetic Tape.

Subcommittee X3.9, Interface Standards, was directed to submit a schedule for the development of device interface standards to the Standards Planning & Requirements Committee (SPARC) for review and transmittal to X3.

X3 requested SPARC to review and submit recommendations to X3 on the proposed scope and program of work of the Composite Language Development Group. This Group is considering the feasibility of standardizing PL/1 in a collaborative effort with European Computer Manufacturers Association and Technical Committee 1, Programing Languages, of the International Federation of Information Processing.

A revised statement of scope, program of work, and operating procedures for Subcommittee X3.5, Terminology and Glossary, and a revised scope and program of work was approved for Subcommittee X3.8, which has been redesignated "Representation of Data Elements."

X3 deferred action on the recommendations of its ad hoc group on Data Descriptive Language and directed SPARC to consider the feasibility of forming a group to identify the conceptual foundation of the structure of a data descriptive language that would provide the vehicle for the development of such a language or family of languages.

STATUS OF FEDERAL INFORMATION PROCESSING STANDARDS

Development Phase

- Signaling Speeds for Data Transmission
- Parallel Signaling Speeds for Data Transmission
- Time Sharing and Remote Console Considerations
- Hardware Interfaces
- Keyboard Configuration
- Synchronous Signaling Speeds
- Numerical Machine Control Perforated Tape
- Vocabulary for Information Processing
- Interchangeable Magnetic Disk Media
- OCR Print Quality
- OCR Paper
- ADP Systems Site Preparation
- Magnetic Tape Labels for Information Interchange
- FORTRAN Standard Reference
- COBOL Programming Language
- Recorded Magnetic Tape for Information Interchange (200 cpi, NRZI)
- Signal Quality at Interface Between Data Processing Terminal Equipment and Synchronous Data Communication Equipment for Serial Data Transmission
- One-Inch Perforated Paper Tape for Information Interchange
- Take-Up Reels for One-Inch Perforated Paper Tape
- Place Codes
- Government Agency Codes

Coordination Phase

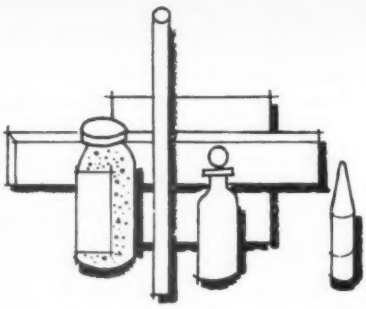
- Bit Sequencing of the Code for Information Interchange in Serial-by-Bit Data Transmission
- Character Structure and Character Parity Sense for Parallel-by-Bit Data Communication
- Character Structure and Character Parity Sense for Serial-by-Bit Data Communication in the Code for Information Interchange
- Hollerith Punched Card Code
- Interface Between Data Terminal Equipment and Data Communication Equipment Employing Serial Binary Data Interchange
- Interface Between Data Terminal Equipment for Data Communication
- Layout of Forms for OCR Input
- Specifications for General Purpose Paper Cards for Information Processing
- Subsets of the Standard Code for Information Interchange
- Rectangular Holes in Twelve-Row Punched Cards
- Codes for Countries, Dependencies and Areas of Special Sovereignty
- Language Codes

Issued Standards and Related Publications [1]

- **FIPS PUB 0** General Description of the Federal Information Processing Standards Register
- **FIPS PUB 1** Code for Information Interchange (FIPS 1)
- **FIPS PUB 2** Perforated Tape Code for Information Interchange (FIPS 2)
- **FIPS PUB 3** Recorded Magnetic Tape for Information Interchange (FIPS 3)
- **FIPS PUB 4** Calendar Date (FIPS 4)
- **FIPS PUB 5** States of the United States (FIPS 5)
- **FIPS PUB 6–1** Counties and County Equivalent of the States of the United States (FIPS 6–1) Revision of FIPS PUB 6 and FIPS 6
- **FIPS PUB 7** Implementation of Code for Information Interchange and Related Media Standards (Supplement to FIPS 1, 2, and 3)
- **FIPS PUB 8** Metropolitan Statistical Areas (FIPS 8)
- **FIPS PUB 9** Congressional Districts of the United States (FIPS 9)

[1] Procedures for purchasing copies of FIPS PUB's may be obtained from the NBS Office of Technical Information and Publications, Room A607, Administration Building, Washington, D.C. 20234, refer to NBS LP58.

STANDARD REFERENCE MATERIALS



BOTANICAL STANDARDS BEING PREPARED

The U.S. Army Natick Laboatory, Natick, Mass., recently cooperated with the NBS Office of Standard Reference Materials in a project to sterilize a series of botanical materials by gamma radiation. These materials, supplied by NBS, are now in the process of being certified for their constituent elements as botanical standard reference materials.

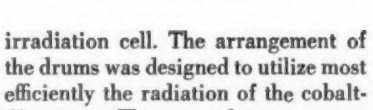
Crop fertilization is no longer the hit or miss operation of a generation ago, but is now based on a scientific appraisal of those elements necessary for optimum crop growth and yield. One technique utilized involves the analysis of the plant leaves for various elements of interest. Then, using the analytical results, the nature and degree of fertilization that must be used to correct any imbalances is determined, and the appropriate fertilizer is applied.

The use of this technique is now widespread enough so that a significant fraction of the analytical work is done through the use of automatic analytical equipment. Such equipment must be frequently calibrated by the use of standards if accurate results are to be obtained. However, no such standards are available. Because of this, the National Bureau of Standards was asked to investigate the possibility of preparing and issuing standard reference materials certified for the important elements in several botanical matrices. This was requested jointly by the American Society for Horticultural Science and the American Society of Agronomy.

As in the case of metals, the methods for analysis of the various constituents of botanical materials are subject to a variety of matrix effects. It was therefore decided that six separate botanical materials would be necessary to represent several important economic crops, namely, orchard leaves, citrus leaves, tomato leaves, alfalfa, pine needles, and aspen chips. Samples of these materials (approximately 500 pounds each) were collected, dried, and pulverized by A. L. Kenworthy, Michigan State University, under an NBS contract. When one considers that a full grown apple tree contains only about 50 pounds of undried leaves, the magnitude of Professor Kenworthy's achievement can be appreciated.

These botanical samples represent a large investment of time and money, and questions concerning their long time stability in terms of decay, or attack by fungi or insects, required immediate consideration. For the first few months after receipt of the material, close watch was kept for possible self-heating of these materials that would indicate a degradation process. Then the possibility of radiation sterilization was suggested and NBS made inquiries along this direction. An offer to carry out this sterilization by gamma radiation was received from the U.S. Army Natick Laboratory. Their only stipulations were that the samples be in drums no more than 15 inches in diameter and that NBS be responsible for delivery to and from the Natick, Mass., laboratory site. To meet the packaging requirement, the various leaves were placed in polyethlyene bags inside fiberboard drums of the proper size.

At the Natick Laboratory, the drums were placed on a specially designed platform within the shielded irradiation cell. The arrangement of the drums was designed to utilize most efficiently the radiation of the cobalt-60 source. The general arrangement of the drums within the irradiation chamber was four drums standing on



The amount of radiation received by the orchard leaves contained within these drums will be measured by the dosimeters being attached by John Holliday of the U.S. Army Natick Laboratory. (Photo courtesy of U.S. Army.)

end with two more laying atop the others. Dosimeters were placed on each drum to measure the amount of radiation received. The radiation source consisted of two panels containing rectangular arrays of ^{60}Co sources. The samples were irradiated for 102 minutes, and the amount of radiation received by the drums as measured by each dosimeter was determined to be about 4.9 megarads. This level of radiation has been shown to sterilize completely materials similar in nature to these samples.

The samples have been returned to the NBS laboratory complex in Gaithersburg, Md., where work is in progress to determine the homogeneity of the orchard leaves by the analy-

NEW WWVH FACILITY

Next year, WWVH, the Bureau's time and frequency station in the Pacific, will be broadcasting from a new site on Kauai in the Hawaiian Islands with an additional carrier frequency, increased power, and a revised format. As a result, far eastern parts of the world will have time and frequency broadcast service of unprecedented reliability. The new facility is now under construction on the west coast of Kauai and broadcasts will begin in the spring of 1971.

Obsolescence, propagation barriers, and a vanishing site are the reasons NBS is abandoning the Maui Island site from which WWVH has been broadcasting since 1948. Part of the station site was a man-made peninsula (which was acquired after World War II as surplus from the Navy) that has been eaten away by the erosive action of the sea. Mountains on both sides of the station interfere with transmission to the north and east where signals are urgently needed, and the equipment is old, obsolete, and in constant need of repairs.

A number of islands in the Pacific were considered by NBS when they began looking for a new site. There was Guam in the Marianas, the Marshalls, Wake, American Samoa, and all of the islands in the Hawaiian Chain. The site on Kauai was chosen for its smooth, level, unobstructed characteristics. It also offered commercially available water and power supplies, accessibility by improved roads, and an airport. In addition, the area is free from electromagnetic interference and there is room on the 35-acre site to space antenna arrays which are harmonically related so they will not interfere with each other.

Each array consists of two vertical masts spaced one-fourth wavelength apart and phased at 90 degrees. The antenna arrays will be located approximately 300 feet from the breaking surf and a radial ground screen around each array will extend over the beach to the ocean, thereby furnishing an infinite ground plane. The standby antennas and the building will be located inland approximately 350 feet from the center line of the operational antennas. In contrast to the old site at Kihei on Maui, this one has an established natural beachline which is not affected by the erosive action of the sea. The building, located inland, will be built on three-foot piers as a precaution against possible inundation by tidal waves.

Antenna towers will be made of galvanized steel pre-dipped in a paint with corrosion preventatives added to combat the effects of salt-water sprays. Transmission lines will be sealed with haberline jackets and buried to prevent corrosion, assure constant impedance, and minimize creeping caused by contraction and expansion.

Very-low-frequency signals (20 kHz) from WWVL, Fort Collins, Colo., will control the master clock at the station. The Fort Collins clock is controlled by the NBS atomic clock at the Boulder Laboratories.

Power at the new station will be increased from 2 kW to 10 kW and three technicians will be added to the staff so the facility can be manned around the clock. (The present low-power operation permits the station to be unmanned during certain periods of the day.) Present broadcast frequencies of 2.5, 5, 10, and 15 MHz will be supplemented with a new 20 MHz frequency to give additional coverage of the serviced area.

The directional antennas of the station will project a cardioid pattern of radio illumination which will cover Alaska to the North, New Zealand to the South, and some major cities of the Orient (Saigon, Singapore, Hong Kong and Calcutta). The Bureau's research on the new site included a computer study which shows that the new WWVH facility will give these key points in the Far East a reception reliability of from 90–99 percent during the hours between 0600 GMT and 1600 GMT, and only slightly less reliability during other hours.

SRM *continued*

sis of statistically chosen samples for three elements of differing chemistry—manganese, potassium, and phosphorous. It is planned to issue the orchard leaves analyzed for 11 elements with a provisional certificate this year. They will be the usual fertilizer elements, nitrogen, phosphorous, potassium, calcium, and magnesium certified at an accuracy level of one percent, plus six of the more important trace elements—manganese, iron, copper, boron, arsenic, and zinc—certified at the five percent accuracy level. Once the work on orchard leaves is well along, homogeneity work will begin on the citrus leaves.

The sterilization of these materials by gamma radiation and their storage in sealed polyethylene bags should render these botanical samples stable for many years. This stability will enable NBS to issue these botanical samples as standard reference materials.

This work is an excellent example of cooperation between federal laboratories to achieve a goal beneficial to the public. The Office of Standard Reference Materials is grateful to A. Brynjolfson, J. Holliday, B. MacDonald, and F. Schaller of the U.S. Army Natick Laboratories for their interest, direction, and cooperation in accomplishing this work.

CONFERENCE & PUBLICATION *Briefs*

12TH SCINTILLATION AND SEMICONDUCTOR COUNTER SYMPOSIUM

The latest developments in radiation detectors and their associated circuitry were discussed in Washington, D.C., March 11–13, 1970 at the 12th Scintillation and Semiconductor Counter Symposium. Joint sponsors of this biennial event were the Nuclear Science Group of the Institute of Electrical and Electronics Engineers, the Atomic Energy Commission, and the National Bureau of Standards.

Scientists from the United States and five other countries presented their work to an audience of over 400. Initiating the Symposium was a general session describing various types of high-energy detectors. Arthur Roberts, National Accelerator Laboratory, stressed the importance of improving the resolution of detectors used at very high energies (GeV's), and of developing new types of detectors for neutral particles.

Nobel laureate Robert Hofstadter, Stanford University, presented significant developments in the field of total absorption detectors, and also stressed improved resolution.

Multiwire proportional counters are used in a wide variety of experiments at all energies. Louis J. Koester, Jr., University of Illinois, discussed the development of integrated circuit amplifiers and discriminators associated with these detectors, and the need for additional knowledge of such properties as the efficiency and output timing of the array assemblies.

A compendium of more specific types of detector systems began with a presentation by H. R. Krall, RCA (England), commenting on the developments of GaP (Cs) dynode multipliers. This material, first introduced to the detector field at the 11th Scintillation and Semiconductor Counter Symposium, provides photomultipliers with high order electron resolution and high counting efficiency because of the extremely high secondary emission.

Joseph A. Coleman, NBS, reported recent material studies related to the limitations on the performance of semiconductor nuclear radiation detectors. He discussed the need for better materials to reduce such built-in limiting characteristics as resistivity inhomogeneities, crystal defects, impurities, and surface effects which all originate during crystal growth.

The Impact of Semiconductor Detectors on X-ray Spectroscopy was the subject of a talk by F. J. Walter, ORTEC, Inc. He commented on the applications of detectors to x-ray spectroscopy, scanning electron microscopy, electron probe analysis, x-ray diffraction, x-ray fluorescence analysis, and x-ray astronomy, relating the analytical usefulness of the method to the detector employed.

George T. Reynolds, Princeton University, stressed the advantages of using image intensifiers in the study of x-ray diffraction. Their use will enable researchers to obtain adequate information following exposures whose time is reduced by factors of several hundred over conventional methods.

Two papers were presented on position-sensitive detectors—one approach to replacing the large bubble chambers used to record particle events. The first was by W. L. Brown and associates of the Bell Telephone Laboratories, who are investigating the use of multiple diode arrays, of the type used in optical sensing in TV camera tubes, as two-dimensional position sensitive detectors of charged particles. The arrays are about one-half square inch in area and contain over 700 000 boron diffused diodes on a single chip.

The second paper, by C. J. Borkowski and M. K. Kopp of the Oak Ridge National Laboratory, presented data on the position and energy resolution of one and two dimensional position-sensitive proportional counters. These detectors provide information about the location of an ionizing event and the subsequent energy loss of a particle. Both the geometric resolution and the energy resolution are extremely good.

The dramatic reduction of amplifier noise in recent years has contributed immensely to the extremely high-energy resolution obtained with semiconductor radiation detectors. Highly sophisticated approaches are being investigated to even further reduce amplifier noise. V. Radeka, Brookhaven National Laboratory, a leading figure in this area, presented a paper in which he proposes elimination of the conventional charge leak resistor and the substitution of a pulsed method for removal of charge.

The banquet address was given by P. R. Bell, former Manager of NASA's Lunar Receiving Laboratory (presently at the Oak Ridge National Laboratory). Dr. Bell spoke about some of the hypotheses of the moon's origin as derived from tests made on the lunar rocks brought back on Apollo 11 and 12. One conclusion is that the moon has a cold, non-conducting, essentially inactive core and an average age of about 4.5 billion years—older than previously supposed.

Proceedings of the Symposium are to be published by the Nuclear Science Group of the IEEE in June. Copies will be available at a cost of $10 each from the IEEE, 345 E. 47th Street, New York, N.Y. 10017.

FOURTH MATERIALS RESEARCH SYMPOSIUM

The mechanism of pyrolysis, oxidation, and burning of organic materials, polymers, and small molecules will be the subject of the 4th Materials Research Symposium. This Symposium, sponsored by NBS, will meet at the Bureau's facilities in Gaithersburg, Md., October 26–30, 1970.

The Symposium will treat three topics—pyrolysis, oxidation, and burning—in a relatively broad but fundamental manner. Subjects to be covered are the gas and condensed phase as well as pyrolytic and oxidative burning mechanisms, including molecular and physical processes. The program format includes sixteen invited speakers with invited discussants.

Further information may be obtained from the Program Chairman, Dr. Leo A. Wall, Room B328, Polymers Building, National Bureau of Standards, Washington, D.C. 20234.

SCHEDULED NBS-SPONSORED CONFERENCES

Each year NBS sponsors a number of conferences covering a broad range of topics in science and technology. The conferences listed below are either sponsored or cosponsored by NBS and will be held at the Bureau's Gaithersburg, Md., facility unless otherwise indicated. These conferences are open to all interested persons unless specifically noted. If no other address is given, inquiries should be sent to the person indicated below in care of Special Activities Section, Room A600, Administration Building, National Bureau of Standards, Washington, D.C. 20234.

1970 Standards Laboratory Conference. Innovative Metrology—Key to Progress. June 15–17. Sponsor: National Conference of Standards Laboratories. Contact: H. L. Mason (NBS Institute for Basic Standards).

55th National Conference on Weights and Measures. July 12–17. Contact: H. F. Wollin (NBS Office of Weights and Measures). To be held at the Hotel Utah, Salt Lake City, Utah.

International Conference on Precision Measurement and Fundamental Constants. Aug. 3–7. Cosponsors: IUPAC; CODATA; National Academy of Sciences–National Research Council; International Bureau of Weights and Measures. Contact: E. Ambler (NBS Institute for Basic Standards).

Space Simulation Conference. Sept. 14–16. Cosponsors: American Institute of Aeronautics and Astronautics; Institute of Environmental Sciences; American Society for Testing and Materials. Contact: J. C. Richmond (NBS Heat Division).

National Conferences on Metrication. Sept. 21–25, Oct. 12–16, and Nov. 16–20. Contact: J. Odom (NBS Office of Invention and Innovation). To be held at Department of Commerce Auditorium, Washington, D.C.

25th Calorimetry Conference. Oct. 19–22. Contact: E. Domalski (NBS Physical Chemistry Division).

4th Materials Research Symposium. Oct. 26–30. Contact: L. A. Wall (NBS Polymers Division).

The Science of Ceramic Machining and Surface Finishing. Nov. 2–4. Cosponsors: Office of Naval Research; American Ceramic Society. Contact: S. J. Schneider (NBS Inorganic Materials Division).

Symposium on the Application of Computers to Environmental Engineering Design. Nov. 30–Dec. 2. Cosponsor: American Society of Heating, Refrigerating and Air Conditioning Engineers. Contact: R. Achenbach (NBS Building Research Division).

HAIL RESISTANCE OF ROOFING PRODUCTS

A test for evaluating the hail resistance of roofing products and results of its use on a variety of roofing materials are described in *Hail Resistance of Roofing Products*,[1] by S. H. Greenfeld, NBS Building Science Series 23 (25 cents, SD Catalog No. C13.29/2:23). Sponsored by the Asphalt Roofing Manufacturers Association, the research included determinations of the hailstone size at which damage occurred, the vulnerability of different parts of the same roof, the effect of weathering, the effect of different substrates, and the effects of the coarseness of the surface aggregate.

SATURATING ROOFING FELTS

Roofing felts, which serve to give a strong backing to weather resistant asphalt coatings, are themselves vulnerable to the weather and need to be protected. This protection, obtained by applying a light bituminous saturant, is sometimes difficult to achieve. *A Study of the Variables Involved in the Saturating of Roofing Felts*,[1] by Sidney H. Greenfeld, NBS Building Science Series 19 (30 cents, SD Catalog No. C13.29/2:19), describes an investigation of the felt-saturation process, including the effects of temperature, pressure, moisture, time, and saturant on the saturation of organic-felt roofing products. The report outlines the experiments made, summarizes the results, and discusses their significance.

54TH NATIONAL CONFERENCE ON WEIGHTS AND MEASURES

Report of the 54th National Conference on Weights and Measures 1969[1] edited by R. L. Koeser, NBS Special Publication 318 ($1.50, SD Catalog No. C13.10:318), is the latest in a series of annual proceedings that is a very readable and informative introduction to the manifold activities and interests of the world of commercial weights and measures. This result is achieved primarily through the texts of about 35 short talks and panel discussions by knowledgeable contributors who discuss many of the technical, economic, organizational, and legal aspects of the field. Further interest is added by emphasis on the relation of these topics to currently debated issues of consumer protection.

[1] Order by SD Catalog number from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402, for the price indicated.

PUBLICATIONS of the National Bureau of Standards*

PERIODICALS

Technical News Bulletin, Annual Subscription: Domestic, $3; foreign, $4. Single copy price 30 cents. Available on a 1-, 2-, or 3-year subscription basis. SD Catalog No. C13.13:54.

Journal of Research of the National Bureau of Standards

Section A. Physics and Chemistry. Issued six times a year. Annual subscription: Domestic, $9.50; foreign, $11.75. Single copy price varies. SD Catalog No. C13.22/sec.A:74.

Section B. Mathematical Sciences. Issued quarterly. Annual subscription: Domestic, $5; foreign, $6.25. Single copy, $1.25. SD Catalog No. C13.22/sec.B:74.

Section C. Engineering and Instrumentation. Issued quarterly. Annual subscription: Domestic, $5; foreign, $6.25. Single copy, $1.25. SD Catalog No. C13.22/sec.C:74.

CURRENT ISSUES OF THE JOURNAL OF RESEARCH

J. Res. Nat. Bur. Stand. (U.S.), **74B** (*Math. Sci.*), No. 2 (April–June 1970), SD Catalog No. C13.22/sec.B:74/2.

Greenberg, L., and Newman, M., Normal subgroups of the modular group.

McKinney, J. E., and Oser, H. J., Acoustic propagation and stability within an inviscid, heat-conducting fluid.

Meyers, P. R., On contractive semigroups and uniform asymptotic stability.

Ng, E. W., and Geller, M., On some indefinite integrals of confluent hypergeometric functions.

Witzgall, C., On complementary polar conical sets.

OTHER NBS PUBLICATIONS

Armstrong, G. T., Hydrogen fluoride and the thermochemistry of fluorine, Nat. Bur. Stand. (U.S.), Tech. Note 513, 21 pages (Feb. 1970), 30 cents, SD Catalog No. C13.46:513.

Bullis, W. M., ed., Methods of measurement for semiconductor materials, process control, and devices. Quarterly report July 1 to September 30, 1969, Nat. Bur. Stand. (U.S.), Tech. Note 520, 69 pages (Mar. 1970), 65 cents, SD Catalog No. C13.46:520.

Greenfeld, S. H., Warner, E. R., Reinhart, H. W., Bibliographies on fabric flammability. Part 1. Wearing apparel; Part 2. Fabrics used on beds; Part 3. Carpets and rugs, Nat. Bur. Stand. (U.S.), Tech. Note 498, 36 pages (Feb. 1970), 40 cents, SD Catalog No. C13.46:498.

Hilten, J. S., Accelerometer calibration with the earth's field dynamic calibrator, Nat. Bur. Stand. (U.S.), Tech. Note 517, 30 pages (Mar. 1970), 35 cents, SD Catalog No. C13.46:517.

Marsden, C. P., Cowan, R. Y., Tabulation of data on semiconductor amplifiers and oscillators at microwave frequencies, Nat. Bur. Stand. (U.S.), Tech. Note 518, 66 pages (Feb. 1970), 65 cents, SD Catalog No. C13.46:518.

Miles, B. M., Wiese, W. L., Bibliography on atomic transition probabilities, January 1916 through June 1969, Nat. Bur. Stand. (U.S.), Spec. Publ. 320, 111 pages (Feb. 1970), (Supersedes NBS Misc. Publ. 278 and Supplement) $1.25, SD Catalog No. C13.10:320.

Paule, R. C., Mandel, J., Standard reference materials: Analysis of interlaboratory measurements on the vapor pressure of gold (certification of standard reference material 745), Nat. Bur. Stand. (U.S.), Spec. Publ. 260–19, 21 pages (Jan. 1970), 30 cents, SD Catalog No. C13.10:260–19.

Technical Highlights of the National Bureau of Standards, Annual Report, Fiscal Year 1969, Nat. Bur. Stand. (U.S.), Spec. Publ. 325, 243 pages (Mar. 1970), $1.25, SD Catalog No. C13.10:325.

PUBLICATIONS IN OTHER JOURNALS

This column lists all publications by the NBS staff, as soon after issuance as practical. For completeness, earlier references not previously reported may be included from time to time.

Becker, E. D., Ferretti, J. A., Farrar, T. C., Driven equilibrium fourier transform spectroscopy. A new method for nuclear magnetic resonance signal enhancement, J. Am. Chem. Soc. **91**, 7784–7785 (1969).

Bender, P. L., Alley, C. O., Currie, D. G., Dicke, R. J., Faller, J. B., Some implications for physics and geophysics of laser range measurements from earth to a lunar retro-reflector (Proc. Conf. NATO Advanced Study Institute, University of Newcastle, Upon Tyne, England, Mar.–Apr. 1967), Chapter in The Application of Modern Physics to the Earth and Planetary Interiors, S. K. Runcorn, ed., pp. 523–530 (John Wiley and Sons Inc., London, England, 1969).

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Brady, E. L., The National Standard Reference Data System, Mater. Res. Std. **9**, No. 10, 19–21 (Oct. 1969).

**Publications with prices and SD Catalog numbers indicated may be purchased directly from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402 (foreign: one-fourth additional). NBS nonperiodical series are also available from the Clearinghouse for Federal Scientific and Technical Information, Springfield, Va. 22151. Reprints from outside journals and the* NBS Journal of Research *may often be obtained directly from the authors.*

CLEARINGHOUSE BIBLIOGRAPHIC JOURNALS**

U.S. Government Research & Development Reports. Semimonthly journal of abstracts of R&D reports on U.S. Government-sponsored projects and U.S. Government-sponsored translations of foreign technical material. Annual subscription (24 issues): Domestic, $30; foreign, $37.50. Single copy, $3.

U.S. Government Research & Development Reports Index. Semimonthly index to preceding; arranged by subject, personal author, corporate author, contract number, and accession/report number. Annual subscription (24 issues): Domestic, $22; foreign, $27.50. Single copy, $3.

***Subscriptions or single copies may be purchased from the Clearinghouse for Federal Scientific and Technical Information, NBS, U.S. Department of Commerce, Springfield, Va. 22151, for the price indicated.*

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